WHAT IS CLAIMED IS:

1. A method for generating animations of the human body including both shoulders and arms modeled by a multi-articulated structure formed by plural rigid sticks connected by joints, said method comprising the steps of:

(a) defining a constraint plane in which said rigid sticks having modeled each of said arms are allowed to move about said joint connecting them;

(b) determining parameters that define angular positions of said rigid sticks in said constraint plane and constructing motion models of said rigid sticks by using said parameters; and

(c) generating motions of said rigid sticks having modeled said each arm by calculating temporal changes in said angular positions of said rigid sticks on the basis of said motion models.

2. The method of claim 1, wherein said step (b) includes a step of selectively applying either a motion modeling scheme using laws of physics or a different motion modeling scheme not based on said laws of physics for said parameters defining said angular positions of said rigid sticks.

3. The method of claim 2, wherein there are prepared a plurality of said motion modeling schemes not based on said laws of physics.

4. The method of claim 2 or 3, wherein said step (b) includes a step of constructing plural motion models for said parameters of said rigid sticks and said step (c) includes a step of performing weighted-combining of parameters generated

by said plural motion models.

5. The method of claim 4, wherein said weighted-combining is linear weighted-combining.

6. The method of claim 4, wherein said weighted-combining is nonlinear weighted-combining.

7. The method of claim 4, wherein weights of said weighted-combining are changed with time.

8. The method of claim 2 or 3, wherein said step (b) includes a step of approximating said motions of said rigid sticks by a physical pendulum to construct said motion models and formulating equations of motion for said models by said physical pendulum to represent said motions of said rigid sticks.

9. The method of claim 2 or 3, wherein said physical pendulum includes two rigid sticks corresponding to upper and lower arms of said each arm and connected at one end by one joint to each other, one of said rigid sticks having its other end connected to the joint of one of said shoulders.

10. The method of claim 2 or 3, wherein said step (b) includes a step of calculating the position of said joint serving as a fulcrum of said physical pendulum of said rigid sticks and said step (c) includes a step of calculating, by said equations of motion, angular positions or angular velocities representing the configurations of said rigid sticks at a certain point in time.

11. The method of claim 10, wherein said step (b) includes a step of constructing a plurality of different models of said motions of said rigid sticks and said step (c)

includes a step of calculating said angular positions or angular velocities of said rigid sticks by using said plurality of different models respectively corresponding thereto and performing weighted-combining of them to represent motion states of said rigid sticks.

12. The method of claim 1, wherein: said step (b) includes a step of approximating said motions of said rigid sticks by a physical pendulum to construct arm models, determining motion modeling equations by applying equations of motion and an interpolation scheme to said arm models, and calculating the position of a joint which serves as a fulcrum of said physical pendulum of each of said arm models; and said step (c) includes a step of calculating, by said motion modeling equations, angular positions or angular velocities representing the configuration of said each arm at a certain point in time and performing weighted combining of said angular positions or angular velocities, thereby representing the motion state of said each arm.

13. The method of claim 12, wherein said step (b) includes a step of determining physical quantities including the lengths, mass, centroids, maximum expansion and bending angles of said upper and lower arms of said each arm for said modeling of motions of said arm models.

14. The method of claim 12, wherein said equations of motion are determined on the assumption that motions of said arm models are motions by models constructed by approximating said joint.

15. The method of claim 12, wherein said equations of

motion are overlapped with functions representing preset motions, thereby representing motions of said each arm.

16. The method of claim 12, wherein the step of calculating the position of said joint includes a step of calculating the coordinate value, velocity and acceleration of said joint regarded as a point in a 3D space.

17. The method of claim 12, wherein said weighted-combining is linear weighted-combining.

18. The method of claim 12, wherein said weighted-combining is nonlinear weighted-combining.

19. The method of claim 12, wherein weights of said weighted-combining are changed with time.

20. The method of claim 12, wherein parameters which defines motions of said rigid stick joining said both shoulders include an angle θ through which said rigid stick is rotated on a vertical coordinate axis passing through the center of said rigid stick joining said both shoulders.

21. The method of claim 20, wherein parameters which defines motions of said rigid stick joining said both shoulders include an angle δ through which said rigid stick is rotated on a horizontal coordinate axis passing through the center of said rigid stick joining said both shoulders.

22. The method of claim 20, which further includes a step of determining an angle ρ between said constraint plane containing said rigid sticks modeling said each arm and said vertical coordinate axis in response to centrifugal force caused by the rotation of said both arms resulting from said rotation of said rigid stick on said vertical coordinate

axis.

23. An apparatus for generating animations of the human body including both shoulders and arms modeled by a multi-articulated structure formed by plural rigid sticks connected by joints, said apparatus comprising:

configuration modeling means for disposing said rigid sticks in respective constraint planes;

shoulder position calculating means for calculating the position of a joint of each of said shoulders;

motion modeling means for determining motion models representing motions of said rigid sticks; and

arm angle calculating means for calculating, for each of said motion models, the angular position of said each arm representing its configuration at a given point in time.

24. The apparatus of claim 23, wherein said motion modeling means includes plural modeling sections for modeling motions of said rigid stick of said each arm with plural different models and said arm angle calculating means includes plural calculating sections for calculating the angular positions or angular velocities of said each arm by using said motion models determined by said plural modeling sections, and which further includes angle combine/output means for performing weighted combining of said plural angular positions or angular velocities calculated by said plural calculating sections of said arm angle calculating means, thereby obtaining the angular position or angular velocity of said each arm.

25. The apparatus of claim 23, wherein said motion

modeling means includes plural modeling sections for modeling motions of said rigid stick of said each arm with plural different models and said arm angle calculating means includes plural calculating sections for calculating the angular positions or angular velocities of said each arm by using said motion models determined by said plural modeling sections, and which further includes motion model select means for selectively designating, for each of said rigid sticks, which one of said motion models by said plural modeling sections is to be used to calculate said angular positions.

26. The apparatus of claim 25, which further comprises said motion modeling means and said arm angle calculating means provided in pairs, said motion model select means of said pairs selecting a different combination of motion models for said each rigid stick, and combine/output means whereby angular positions or angular velocities output from said arm angle calculating means of said pairs are subjected to weighted combining for each corresponding rigid stick.

27. The apparatus of claim 24 or 25, wherein said plural motion models include motion models determined by an equation of motion based on laws of physics and motion models based on an interpolation scheme.

28. The apparatus of claim 27, wherein said motion models based on said interpolation scheme include a motion model of the motion of said each rigid stick by approximating it by a uniform angular velocity motion and using a linear interpolation scheme, a motion model of the motion of said

each rigid stick by approximating it by a sine function and using a sine function interpolation scheme, and a motion model of the motion of said each rigid stick by using an equation of motion which obeys laws of physics.

29. The apparatus of claim 24 or 25, wherein said configuration modeling means is means for modeling the motion of said each arm as a physical pendulum with its fulcrum at each of said shoulders.

30. The apparatus of claim 29, wherein said physical pendulum contains two rigid sticks corresponding to upper and lower arms of said each arm and connected at one end by a joint to each other, one of said rigid sticks having its other end connected to the joint of one of said shoulders.

31. The apparatus of claim 23, wherein said motion modeling means is means for modeling the motion of an arm model of said each arm and the motion of a shoulder model of each of said shoulders independently of each other.

32. The apparatus of claim 23, wherein said motion modeling means is means for modeling by overlapping an equation of motion of an arm model of said each arm with a preset function representing a motion.

33. The apparatus of claim 23, wherein said configuration modeling means includes means whereby said rigid stick having modeled said shoulder is modeled so that it rotates at its center lengthwise thereof about a vertical coordinate axis within the range of a predetermined angle θ.

34. The apparatus of claim 23, wherein said configuration modeling means includes means whereby said rigid stick having

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modeled said shoulder is modeled so that it rotates at its center lengthwise thereof about a horizontal axis within the range of a predetermined angle δ.

35. A recording medium which has recorded therein a procedure for generating animations of the human body including both shoulders and arms modeled by a multi-articulated structure formed by plural rigid sticks connected by joints, said procedure comprising the following sequence of operations:

(a) defining a constraint plane in which said rigid sticks having modeled each of said arms are allowed to move about said joint connecting them;

(b) determining parameters that define angular positions of said rigid sticks in said constraint plane and constructing motion models of said rigid sticks by using said parameters; and

(c) generating motions of said rigid sticks having modeled said each arm by calculating temporal changes of said parameters.

36. The recording medium of claim 35, wherein said operation (b) includes an operation of selectively applying either a motion modeling scheme using laws of physics or a different motion modeling scheme not based on said laws of physics for said parameters defining said angular positions of said rigid sticks.

37. The recording medium of claim 35, wherein: said operation (b) includes an operation of approximating said motions of said rigid sticks by a physical pendulum to

construct arm models, determining motion modeling equations by applying equations of motion and an interpolation scheme to said arm models, and calculating the position of a joint which serves as a fulcrum of said physical pendulum of each of said arm models; and said operation (c) includes an operation of calculating, by said motion modeling equations, angular positions or angular velocities representing the configuration of said each arm at a certain point in time and performing weighted combining of said angular positions or angular velocities, thereby representing the motion state of said each arm.

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